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THE EFFECTS OF pH ON THE DISTRIBUTION OF THE MEGATHYMIDAE

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From my first capture of a member of the Megathymidae (a specimen of *Megathymus yuccae stallingsi* Freeman) at Vickery, Texas, April 12, 1938, a keen interest was developed in this group of butterflies. The close association of the Megathymidae with their host plants, *Agave, Yucca* and *Manfreda,* has led to the study of some very interesting habitats. At first, it was a matter of locating the adults on the wing and of trying to catch them with a net. That, however, was difficult and often resulted in damage to the specimen and sometimes to the collector. As knowledge about the life histories of the various species developed, techniques were devised for collecting the larvae and pupae. The net was then put aside and in its place such equipment as a fox hole pick, bayonet, and drain spade took its place. Records of the distribution of the various species of *Agave, Yucca,* and *Manfreda* were studied and from this information, various collecting trips were made which resulted in the discovery of many interesting new species of Megathymidae. It was thought provoking that a perfectly fine stand of *Yucca* did not always result in the finding of a colony of *Megathymus,* whereas within a short distance a much less favorable-looking area would have plants attacked by the larvae. Now, it is known that there are several factors in the environment that govern the survival of a colony of these insects in a given habitat. One particular factor, the pH of the soil, attracted attention about six years ago and since that time soil samples have been carefully checked from all of the study habitats under consideration. The knowledge so obtained explains in part why success has not always been had in locating larvae in apparently fine stands of both *Yucca* and *Agave.*

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Along with Stallings and Turner, a rather extensive study of *Agathymus mariae* (B. & B.) and its related species has been made. In carrying on this present study, 33 locations were selected by the author; these extend from El Paso and Carlsbad National Park to Boquillas Canyon, and to the north of Bracketville, Texas, where *Agave lecheguilla* Torr. occurs. At each location, the following factors were checked, pH of the soil, type of soil, elevation, plant associates, average annual rainfall, and presence or absence of radiation with Geiger counter. The most significant factor seemed to be the pH of the soil. It was found that *Agathymus mariae* occurred where ever the pH ranged from 7.3-8.9, with the average being slightly below 8, indicating that it is best suited to live where the soil is alkaline. In the southeastern section of the study habitats, the pH was around 7, indicating neutral soil; *mariae* was not found in these areas, but instead *Agathymus estelleae* (Stallings & Turner) and three new species (that are now in the process of being named) were found.

The following data has been found on the other species of *Agathymus* that occur in Texas. *Agathymus florenceae* (Stallings & Turner) occurs where the pH of the soil ranges from 5.9-6.1, *A. carlsbadensis* (Stallings & Turner) around 7.9, *A. judithae* (Stallings & Turner) around 7.3, *A. diabloensis* Freeman around 7.4, *A. mcalpinei* (Freeman) around 7.4-7.6, *A. chisosensis* (Freeman) around 5.2. The last indicates the strongest acid soil relationship.

In Arizona it was found that *Agathymus aryxna* (Dyar) is associated with soil where the pH ranges from 5.3-6.1, and *A. polingi* (Skinner) from 5.8-6.1.

In Texas, there are several subspecies of what are now called *Megathymus yuccae* (Bdv. & LeC.). It has been very interesting to see how the pH of the soil is related to the distribution of these subspecies. The first subspecies studied, *stallingsi* Freeman, occurs from north central Texas, Oklahoma to Caldwell, Kansas. In Texas, it is associated with limestone outcroppings where the pH is usually just under 8. East of the Dallas area, there is a distance of about seventy miles where the soil changes from alkaline, through neutral to distinctly acid. In the neutral area, no colonies of *Megathymus* have so far been located even though there are fine stands of *Yucca* present. At Canton, Ben Wheeler and Tyler State Park, the soil ranges from pH 4.9-5.1. In this area a different subspecies is found which was recently named

reinthali Freeman. This is a sandy soil subspecies associated with pines and oaks. In the Rio Grande Valley, the subspecies *wilsonorum* S. & T. is associated with sandy soil and scrub bushes but the soil ranges from pH 7.4-7.8. In the Del Rio area, the subspecies *louiseae* Freeman is found. Here, the pH is very near pH 7, indicating a neutral soil relationship. In the extreme western part of Texas, the subspecies *reubeni* S., T. & S. is found in the Hueco mountains where the soil is alkaline, ranging from pH 7.3-7.6. Another subspecies (not yet named) was found in western Texas where the soil was very sandy and the pH was acid, averaging pH 5.

Other *Megathymus* records for Texas indicate the following results. In areas where *Megathymus texanus* B. and McD. have been collected, the pH ranges from 7.-7.6. At and near the type locality of *Megathymus violae* S. and T. the pH was 7.5. In the Big Bend National Park, where *M. violae* is found the pH is 7.4.

In the Tucson, Arizona vicinity, where the pupae of *Megathymus ursus* Poling were collected by myself the pH ran from 5.8-6.

During August 1962, in association with the Stallings, a study was made of 22 selected habitats in north central Mexico, extending from General Bravo down through Victoria to Antiquo Morelos, up through Saltillo, over to Torreon and then through Monclova to Allende. It was found that *wilsonorum* from near China occurred in areas where the pH was identical to its habitat in the Rio Grande Valley. The specimens collected of a *violae*-like species from El Tepeyac were associated with very dusty soil that had a pH of 6.1. *Agathymus estelleae* was found at several locations and the pH of those areas varied from 6.9-7.3. *Agathymus remingtoni* (S. and T.) was collected in areas where the pH was 5.-5.5. *Aegiale hesperiaris* (Walker) was found where the pH was 6.9-7. *Agathymus micheneri* S., T. and S. was found where it was 7. There are several species involved in the *mariae* complex from various locations studied. All were found where the pH was on the alkaline side of the range or nearly neutral and never where the soil was acid. There were other species involved in this study; however, until their exact status is determined I will omit them from this discussion.

No correlation was established between the presence or absence of certain species in a given environment due to radiation effects, because none of the areas studied showed to any pronounced degree the presence of radioactive particles.

The elevation of colonies was important to some extent in most species studied because the presence or absence of the host plants was correlated with elevation. Together with this was an indication of the presence of other plant associates. Correlation with type of soil appeared to be in direct relationship to the pH in most instances. The average rainfall seemed to have less to do with the presence or absence of certain species of Megathymidae than was previously thought. It was observed that west of Saltillo towards Torreon, the *Agave lecheguilla* were yellow or brown due to aridity yet the larvae of various *Agathymus* were present in the plants in more or less large numbers.

From all the data collected over the past six years, the opinion has been drawn that the pH of the soil is one of the most important factors governing the distribution of various species and subspecies of the Megathymidae, and in the selection of host plants. A listing of food plants of this group of insects together with the pH of the soil where found is given in Freeman (1963).

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